THE PHYSIOLOGICAL ACTION

—AND—

THERAPEUTIC USES

—OF THE—

"Acidum Phosphoricum Dilutum."

BY JUDSON B. ANDREWS, M. D.,

ASSISTANT PHYSICIAN IN THE NEW YORK STATE LUNATIC ASYLUM.

From the American Journal of Insanity for October, 1869.

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We present a few statements of others in regard to the circumstances affecting the excretion of phosphoric acid in a state of *health* and of *disease*.

The average daily amount excreted in health, as determined by various observers, is 3.5 grammes, or about 54 grs. Vogel says this is increased by the ingestion of soluble phosphates, of substances capable of being converted into phosphoric acid, or of the acid itself; also, that it is much greater under an animal than a vegetable diet. Mosler states that this amount is doubled under the use of a diet rich in nitrogenous elements, and also that increased activity of the nutritive functions, or of the kidneys, or both, largely increases it.

Vogel has made observations in more than a thousand cases of disease, and his conclusion may be thus briefly stated. There is a large increase of the secretion of this acid in those diseases in which there is increased metamorphosis of the phosphorus-containing tissues.

* Read before the Oneida County Medical Society, in July, 1869, and published by resolution of the Society.

Chemical analysis demonstrates the fact that the nervous system is largely supplied with phosphorus. It is also as liable to destructive changes in disease as any of the tissues of the animal economy. The amount of phosphates which load the urine after a period of mental fatigue, is in excess of that attending muscular exercise, even when severe and long continued.*

In insanity and other neuroses, we would look for the most marked changes in the excretion of the phosphates. Dr. Sutherland,† after extensive analyses of the urine in the insane, has given the following general conclusions:

1. A *plus* quantity of phosphates exists in the urine in the paroxysm of acute mania.

2. A *minus* quantity exists in the stage of exhaustion in mania, in acute dementia, and in the third stage of paralysis of the insane.

3. The *plus* quantity of phosphates in the urine in cases of acute mania, denotes the expenditure of nerve force, and is not a proof of acute inflammation in this disease.

In acute mania we have increased cerebral activity, generally carried to the point of fatigue and weariness. This condition corresponds with the maximum excretion of the phosphates.

In dementia, or mental enfeeblement, and in acute mania with exhaustion, when mental activity is at its minimum, the secretion of phosphates is diminished beyond that of a state of health. These conclusions coincide in a marked degree with the most recent in-

* Our attention has been directed to the paper of Dr. Wood, as published in the transactions of the Connecticut State Medical Society. His experiments seem to prove that the amount of phosphoric acid is not increased in the urine from ordinary mental effort. They are however physiological; and, as the Doctor himself says, in no one of the experiments was mental effort carried to the point of fatigue.

† Beale on Diseases of the Kidney and Urinary Deposits, p. 209.

vestigations on the excretion of urea, considered as a measure of the metamorphosis of muscular tissue. This is most marked when muscular exercise has reached the point of fatigue. We may thus deduce the general facts that in cases of cerebral activity, characterized by fatigue or weariness, there is increased excretion of phosphates; and that in diseases involving destruction or decay of nerve tissue, there is also increased excretion of the phosphates.

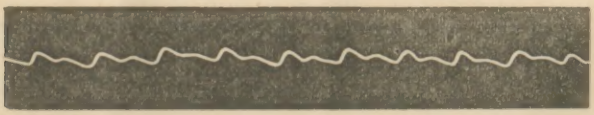
That in cases of mental exhaustion or enfeeblement there is a diminished secretion.

The last statement is but the converse of the other two, that while the cause has ceased operating the effect is no longer observed. It however makes manifest the treatment to be adopted, to repair the waste which the nervous system has suffered, and again bring the secretions to a normal standard. To do this we have the means pointed out in the ingestion of food rich in nitrogenous elements, of substances capable of being converted into phosphoric acid, or of the acid itself. The former of these methods has always been resorted to by practitioners; the latter has attracted little notice.

To demonstrate the physiological action of the remedy, pulse traces are presented taken by the sphygmograph, after the ingestion of the acid. The amount of acid taken varied from one to three drams, and the traces were made at intervals of from fifteen minutes to one hour.

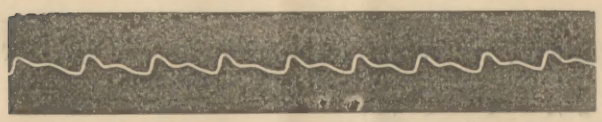
PHYSIOLOGICAL EXPERIMENT No. 1.

Dose of the acid taken, one dram.—Trace before taking acid.

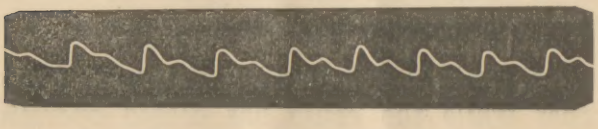


Fifteen minutes after taking acid.

Thirty minutes after taking acid.



One and one-fourth hours after taking acid.

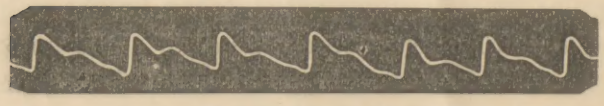


Two hours after taking acid.

PHYSIOLOGICAL EXPERIMENT No. 2.

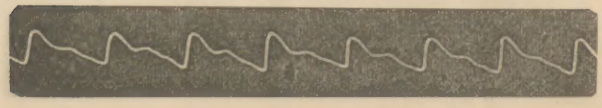
Dose of acid, two drams.—Trace before taking acid.

One-half hour after taking acid.



One hour after taking acid.

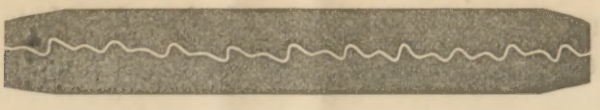
One and one-half hours after taking acid.



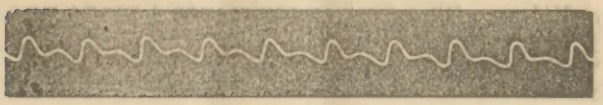
Two hours after taking acid.

PHYSIOLOGICAL EXPERIMENT No. 3.

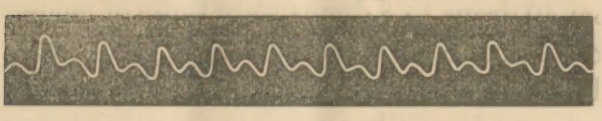
Dose of the acid taken, three drams.—Trace before taking acid.



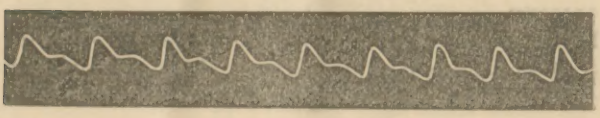
One-half hour after taking acid.



One hour after taking acid.

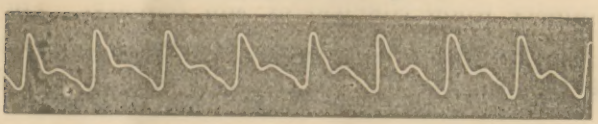


One and one-half hours after taking acid.

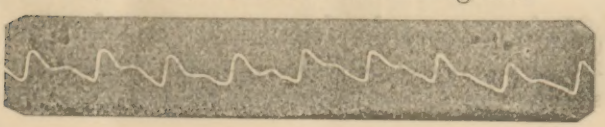


Two hours after taking acid.

Three hours after taking acid.



Four and one-half hours after taking acid.



Six hours after taking acid.

Within the first interval there is an appreciable increase in the force of the pulsations, though there is little change in the number during the whole time of experimentation. The increase is most marked after the lapse of from one to two hours, and it is not till after several hours that the pulse returns to its normal condition. The first experiments I made upon myself, beginning with 20 drops, and continuing the use of the remedy in increased doses till the amount of four drams was reached. The sensations experienced on taking from 40 drops to 3 drams were those of moderate alcoholic stimulation. There was slight pain through the frontal region, and a buoyancy and lightness of feeling rather agreeable. When a larger dose was taken there was a feeling of drowsiness, an inclination to lie down, and an unwillingness to undertake mental labor. This continued for some hours. From these experiments, we may conclude that this remedy is a stimulant general in its character, but with a special tendency to the nervous system.*

It also exercises a marked control over the vaso-motor system, as will be shown further on. We present some pulse traces from patients who have been for some time continuously upon the use of the remedy. They are taken at random from a large number. In them the change in the tone of the circulation may be noted.

*The following extract is from the Dict. Sciences Medicales: "The primary influence of phosphorus is exercised upon the nervous system, of which it increases the sensibility; from that it reacts upon the entire economy, and particularly on the circulatory system; the pulse is developed, heat augmented, the strength is increased."

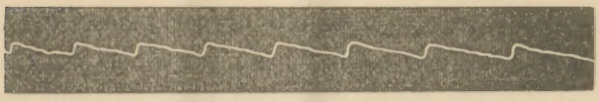
Additional force is manifest in the heart's action in all cases where the traces were taken, and in others the same fact was evidenced by the general appearance. From our experience, we think it properly placed in the category of nerve tonics.

PATHOLOGICAL TRACES. CASE No. 1.

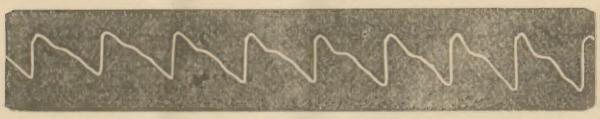
Dose of acid, one-half dram.—Trace before taking acid.

On use of acid two weeks.

On use of acid six weeks.

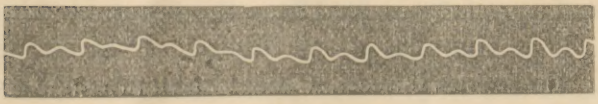


On use of acid four months.

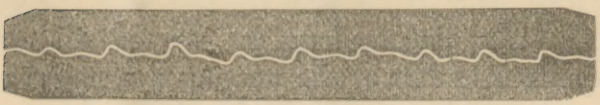


PATHOLOGICAL TRACES. CASE No. 2.

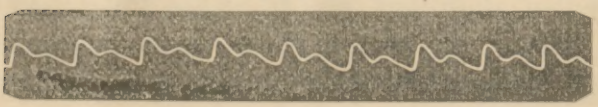
Trace before taking acid.



On use of acid three weeks.



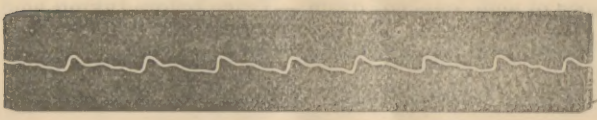
On use of acid two months.



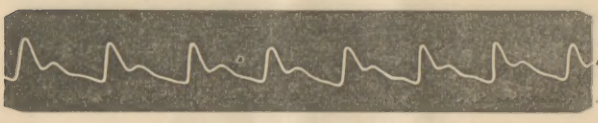
PATHOLOGICAL TRACES. CASE No. 3.

Dose of acid, one-half dram. Trace before taking acid.

On use of acid two weeks.



On use of acid six weeks.



The therapeutic uses of this remedy as given in the books are briefly as follows: It has been, in common with the mineral acids, considered a tonic and refrigerant. It is recommended to allay the thirst attending diabetes; also to remove the unusual deposits in exostoses, and as a tonic in typhoid fever. Macnamara says that of all the mineral acids it is one, "the prolonged administration of which, the system will best tolerate;" a fact which is to be accounted for by its presence in flesh and especially in food from the vegetable kingdom, and it is to the absence of this acid from the diet of sailors, that scurvy is in a great measure to be attributed. It has been ascertained that lemons owe their superiority over citric and tartaric acid, to this ingredient. At the Asylum the use of this remedy has been in disorders of the nervous system, as a brain and nerve nutriment and tonic. It is given on the theory that phosphoric acid furnishes direct food to the nerve tissues; for, as a medical writer has tersely remarked, "we can starve the brain by withholding phos-

phorus." The quantity of this element found in nervous matter varies considerably at different periods of life. By analysis, the minimum is found in infancy, in old age and idiocy; or in figures, phosphorus in the brain of infants, amounts to 0.80 of one per cent.; in youth to 1.65; in adult life 1.80; old age 1.00; in idiots 0.85. In insanity there are some conditions which sustain a close resemblance in mental characteristics to the enfeeblement of age, and others to a state of idiocy. In cases marked by increased mental activity, there is following this a period of mental weakness or enfeeblement, which usually bears a certain relation in degree to the prior excitation. Were the patient acutely maniacal, from this state of exaggerated mental action and tension the mind passes to one of apparent inaction, of more or less complete relaxation. The patient is said to be dementing. He may be profoundly indifferent to external things, perhaps even to the demands of nature, and need the care bestowed on infants. The physical signs of this state are well marked. The appetite is generally good, and the power of digestion unimpaired. Adipose matter often accumulates rapidly to a marked degree. The facial expression is changed; those lines which in health indicate mental life and character, and make manifest the soul that animates the body, are more or less effaced: the countenance loses expression, and sometimes resembles the face of a man drawn on the flat surface of clay rather than that of a human being endowed with life and mind. The action of the skin is impeded; it is often unctuous to the sight and touch, and loses more or less completely its sensibility and elasticity. In fact as a nervous expansion it is measurably paralyzed. The circulation is disturbed in common with the other functions of the animal economy. In the extremities of the body, the ears

and lips, there is a passive congestion often so marked, that the skin is of a dark blue color, cold to the touch, and sometimes swollen almost to bursting. The lips are enlarged and everted, and a well-marked line exists separating the congested external surface from the internal mucous lining. Such are some of the more prominent physical signs present in dementia. This is a period of nervous exhaustion, of reaction from the increased mental and physical activity which marked the previous state of the disease. At this time tone and vigor must be supplied to the prostrated system, and in the accomplishment of this, phosphoric acid is of material service. Nature has made provision for the repair, in the generally unimpaired and often greatly increased vigor of the digestive function, and it may be effectively assisted in this process of restoration by the employment of this acid, as a nerve nutriment. The traces marked number one of the pathological series, are those of a case to which this description will apply. Since being placed on the acid the change in the character of the circulation is strikingly apparent, and the improvement in the appearance and mental condition of the patient very marked. The congestion of the extremities and lips has given place to a more natural color, and the countenance wears the expression of a greater degree of mental vigor and activity. From this point to a full recovery the steps are usually sure and often rapid. Among the first cases which impressed me particularly with the influence of this remedy, soon after my entrance upon duty at the Asylum, was the following:

A young man 28 years of age, of more than ordinary intelligence and education, worn down with the labor of an extensive business connection, was admitted with acute mania, with strong suicidal tendencies. His at-

tempts at self-destruction were various and often repeated: one cut upon the wrist barely failed to reach the radial artery. Several times he dashed his head against the wall and the floor, with the idea of inflicting injury. Restraint and constant vigilance were necessary for his protection. After a few weeks the violence of the attack seemed to subside, and he passed into a well-marked condition of dementia.

His head was downcast; his countenance and extremities presented the usual physical signs elsewhere enumerated. He became very filthy in his habits, passing his excrements in his bed and clothing. His condition was such as would seem to present little hope of recovery. He was given the acid in 20 drop doses. After a week he refused it, and for a short time it was discontinued. There being no improvement in his condition, the remedy was renewed. A week from this time improvement was manifest. He began to talk, at first with hesitation: said his head was mixed, that his mind could not grasp anything; that everything seemed to retreat from him. He appeared confused, and put his hand to his head in a perplexed way. The mind slowly regained its strength, and the patient in passing to recovery again became suicidal. On one occasion he was found suspended from the bed-post, and nearly strangled. Renewed vigilance was now demanded to prevent the accomplishment of his designs upon his life. From this condition he gradually emerged, and became rational in speech and manner. The acid was continued during the greater part of his convalescence, in doses of 30 drops, to which it had been raised. After a period of ten months treatment in the Asylum, he was discharged fully recovered.

Another patient was received into the Asylum suffering under melancholia, with the following history. He

had recently failed in business, and during the settlement of his affairs lost much sleep and became depressed. About three weeks before admission, while sitting in the garden one afternoon, he suddenly manifested great excitement, and made attempts to commit suicide. All instruments by which this might be accomplished were removed from his reach. The paroxysm soon passed, and the patient was quiet but gloomy; said he was to be cut up; that his flesh was to be stripped from his bones. He refused food and drink for three days in succession; his secretions were much disturbed, urine retained and bowels constipated. He slept little, and for some nights before admission not at all. At times he was much excited, obstinate, difficult of care, and often tried to denude his person.

In the Asylum, he was at first dull and stupid, stood quietly on the ward, with his head down and silent. He was careless in dress and uncleanly in his habits. When visited by friends he recognized them, but said he was in Albany at the hotel. He again refused food, saying it was a sin for him to eat; that the Lord had told him not to. He was forcibly fed. Soon after he had a paroxysm of frenzy, in which he threw himself around in the most furious manner, and endeavored to kill or seriously injure himself. This he persisted in till overcome with the exertion. From this time he suffered less acutely, and soon passed into dementia, well-marked in both the mental and physical characteristics. He sat all day on the ward without speaking or noticing any person or thing; had no distinct recollection of his home or family. He gained in flesh, ate and slept well, became filthy in his habits. At this period of the disease phosphoric acid was prescribed in half dram doses. After some two months, improvement was manifest. The congested lips and extremities assumed a more

normal appearance, and the sluggish circulation again approached a healthy standard. Increased mental life and greater regard for personal cleanliness were manifested. From that time to the present, now about three months, improvement has been gradual, but well characterized, and the patient, judging from present progress, will soon regain his mental integrity, and be restored to his family, who long ago gave up a belief in his recovery or permanent benefit. He still takes the acid. This case is given, as it was one in which the prognosis was for a long time very unfavorable, and which seemed to derive marked advantage from the remedy.

Many instances of like character might be adduced to prove the efficacy of the remedy. The congestion of the extremities and lips, which has been mentioned as peculiar to this state of dementia, is attributed to a partially paralyzed condition of the vaso-motor system.

This opinion has long been entertained and advanced by Dr. Gray, the Superintendent, and by him my attention was first directed to the fact that the depth of color and capillary congestion was not due either to defective oxygenation of the blood, or to interrupted or sluggish transmission of nerve force, as electricity had little or no influence. The conclusion therefore seemed warranted that it was a paralysis of the peripheric vaso-motor nerves, dependent on deficient nerve nutrition.

The power of the acid over this nerve tissue is demonstrated by its affording, so generally, a relief to the overloaded capillaries of the more remote portions of the body. In the milder forms of prostration, when the reaction from nervous excitation is less marked, the effects of this remedy are equally apparent. The case marked No. 2, of the pathological pulse traces, was one of this character, and, when admitted to the Asylum, was complicated with attacks of hysteria, of a

cataleptic type, and of an aggravated form. Since being placed on the use of phosphoric acid, the attacks of hysteria have subsided, and the patient has regained mental strength to a marked degree.

Cases are sometimes under treatment at the Asylum, and more frequently in private practice, especially from among literary, professional or business men, which are characterized by loss of mental power from excessive brain activity.

The patient is languid, unable to perform mental labor with the usual facility, is nervous, at times fearful, timid and agitated; the memory is weakened, and permanent impairment seriously threatened. Examination reveals no organic lesion, but the symptoms are such as justly occasion alarm. Such cases have been improperly called by some recent writers cases of cerebral paresis, a term too strong in its import, but expressive of the great danger which impends. For the recovery of these cases, relaxation from business and labor, and the use of the phosphoric acid, combined with some suitable tonic, generally suffices.

In cases where mental effort has been protracted till a sense of weariness renders its continuance difficult, a dose of the acid, from its stimulant effect, relieves fatigue and seems to invigorate the mental powers, and prepare the mind for renewed exertion.* In the night sweats

*A professor in one of our Medical Schools in a letter to Dr. Gray, recently remarked: "Wonderful thing that phosphoric acid, and well named by me psychological lemonade. My lunch at noon (we dine at six) consists of rich cheese, bread, and a glass of phosphoric acid lemonade; and on that I have worked eight and nine hours a day, with my pen, for the past seven weeks in this hot weather, without headache or any depression. I never take over fifteen drops, and only once a day, and when fatigued. It is wonderful how quick it climbs into the anterior lobes, scatters capillary congestion, and satisfies the hungry tissue with its own pabulum."

attending consumption, and other exhausting diseases, this acid is employed with benefit, and has some advantages over the aromatic sulphuric acid, so generally used. It is much more agreeable to the taste, more likely to be tolerated, and does not constipate the bowels. The anti-scorbutic power of this acid is well settled. A marked case of purpura occurred in the Asylum recently. The patient had been an inmate for several months, and though eating the ordinary diet of the house, in which vegetables are bountifully supplied, became scorbutic. The gums were red and spongy, there was lassitude, soreness of the muscles, and an eruption presenting the forms of petechiæ and vibices upon the anterior of the chest and the inner surface of the thighs.

The patient was given the acid in half dram doses, and in two weeks entirely recovered. In cases of anæmia and chlorosis, in both of which there is a depressed condition of the nervous system, phosphoric acid in combination with ferruginous tonics, has been found especially efficacious.

At the Asylum, as an adjuvant for the solution of quinia in water, phosphoric acid is now substituted for the sulphuric acid, with the advantage of increasing the tonic properties of the solution. In giving quinia, we have in cases marked by great nervous prostration, and accompanied with profuse perspiration, found this acid in half dram doses a valuable addition, and one that seems to increase the power of the alkaloid. To the ordinary elixirs, tinctures and decoctions of bark, the acid forms an important aid, and by its acidity it overcomes to a great degree the unpleasant taste of the vegetable bitters.

Observation here confirms the views of Nelligar and others, that this substance exerts no direct influence on

the generative function. It has thus been employed on theoretic grounds; but any favorable influence it has exerted has probably been owing to its general tonic effect. We have used it extensively, and in cases where this function was abnormally excited; and in no instance has its administration been suspended from this cause, or has any inconvenience resulted from its use.

Phosphorus in substance is now recommended in many of the Journals, in some forms of paralysis, in locomotor ataxy, and in other of the neuroses. It is an element difficult to dispense and dangerous to administer. In the stomach it is converted largely into phosphoric acid. It is from this change taking place in the stomach, that the danger is to be apprehended. Is it not better to employ the acid, which in proper doses is harmless, than to incur the risk of consequences in giving phosphorus in substance?

In the administration of this remedy, one general principle should be kept in mind, viz.: not to exhibit it in cases of congestion of the brain, or in those in which there is an inflammatory action, either in the nerve substance or the meninges, as its stimulant effect might prove an aggravation to existing disease. In no case in which it has been given, has it disturbed digestion or proved an irritant to the stomach, even when its administration has been prolonged.

When the remedy was first employed at the Asylum, the dose was 10 drops three times a day; this has been gradually increased till now the standard dose is a half dram. This is given in water alone, or with simple syrup, with which it makes a pleasant and agreeable lemonade. The large doses spoken of were thus taken. In the various combinations with other remedies, the dose varies from 10 to 20 drops. A favorite tonic remedy, which makes an eligible preparation, and one very palatable, is as follows:

R.

Acidi Phosphorici Dil.,	one oz.
Elix. Calisay.,	four oz.
Elix. Valer Ammon.,	two oz.
Glycerinæ,	three oz.
Sherry Wine,	six oz.

Dose, from one half to one oz.

It is from an experience in the use of this remedy in more than two hundred cases, extending over a period of several years, that confidence has been inspired in its general adaptation to the treatment of diseases marked by debility of the nervous system.